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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/590,352
Filing Date: May 21, 2007
Appellant(s): VAN DER LAAN ET AL.

Eric B. Compton
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 08/19/2010 appealing from the Office action mailed Final 02/19/2010.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

2003/0048458	MIEHER ET AL.	03-2003
6,917,901	BOWLEY, JR. ET AL.	07-2005

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-12, 16-19, 22-33, and 37-40 are rejected under 35 U.S.C. 102(e) as being teached by Mieher et al. (Publication No. US 2003/0048458). Hereafter, "Mieher".

Regarding Claim 1, Mieher teaches obtaining calibration spectral measurement data ([0044-0045]) from a plurality of calibration marker structure sets provided on a calibration object (paragraph [0032], lines 1-6), each of said plurality of calibration marker structure sets comprising at least one calibration marker structure ([0032], lines 6-17), calibration marker structures of different calibration marker structure sets being created using different known values of said at least one process parameter (paragraph [0032], lines 17-21, [0039], [0045], [0058]);

determining a mathematical model by using said known values of said at least one process parameter ([0056], [0060]), (equations model is not different from mathematical model) and by employing a multi-variant regression technique ([0080], lines 7-24) on said calibration spectral measurement data (paragraph [0080]), said mathematical model comprising a number of regression coefficients (paragraphs [0061]-[0065] and [0066] lines 1-3);

obtaining spectral measurement data from at least one marker structure provided on a object ([0009]-[0010], [0037], lines 1-7), said at least one marker structure being made using an unknown value of said at least one process parameter ([0037], lines 4-17, [0058], [0060], [0088]);

comparing the obtained spectral measurement data with the calibration spectral measurement data ([0047], [0080], lines 7-13), to determine the unknown value ([0008], (determine the values means these values are unknown before), [0080], lines 12-13), (the error is reduced to the specified value) of said at least one process parameter for said substrate from said obtained spectral measurement data (paragraph [0008]) by employing said regression coefficients of said mathematical model (paragraph [0060], [0080], claims 16, 17); and

adjusting a control parameter of a lithographic apparatus (figure 1) based on the unknown value of said at least one process parameter for said object in the device manufacturing process ([0080-0090], figures 2-4).

Regarding Claim 22, Micher teaches

a detector arranged ([0048]) to obtain calibration spectral measurement data ([0044-0045]) from a plurality of calibration marker structure sets provided on a calibration object (paragraph [0032], lines 1-6), each of said plurality of calibration marker structure sets comprising at least one calibration marker structure ([0032], lines 6-17), calibration marker structures of different calibration marker structure sets being created using different known values of said at least one process parameter (paragraph [0032], lines 17-21, [0039], [0045], [0058]);

a processor unit ([0080], lines 19-21) storing a mathematical model by using said known values of said at least one process parameter ([0056], [0060]), (equations model is not different from mathematical model) and by employing a multi-variant regression technique ([0080], lines 7-24) on said calibration spectral measurement data (paragraph [0080]), said mathematical model comprising a number of regression coefficients (paragraphs [0061]-[0065] and [0066] lines 1-3);

said processor unit being arranged to obtain spectral measurement data from at least one marker structure provided on a object ([0009]-[0010], [0037], lines 1-7), said at least one marker structure being made using an unknown value of said at least one process parameter ([0037], lines 4-17, [0058], [0060], [0088]);

and to compare the obtained spectral measurement data with the calibration spectral measurement data ([0047], [0080], lines 7-13), to determine the unknown value (([0008], (determine the values means these values are unknown before), [0080], lines 12-13), (the error is reduced to the specified value) of said at least one process parameter for said substrate from said obtained spectral measurement data (paragraph [0008]) by employing said regression coefficients of said mathematical model (paragraph [0060], [0080], claims 16, 17); and

Regarding Claims 2, 3, 23, 24, Micher teaches calibration measurement data and said measurement data are obtained with an optical detector ([0048]), (it is obvious to have a scatterometry technique used to measure the grating structure having beams detected by using optical detector).

Regarding Claims 4, 25, Micher teaches multi-variant regression technique used by the mathematical model is selected from a group consisting of principal component regression, non-linear principal component regression, partial least squares modeling and non-linear partial least squares modeling (paragraph [0080], lines 7-14).

Regarding Claims 5, 6, 26, 27, Micher teaches substrate comprising one of the groups consisting of a test wafer and a product wafer (paragraph [0010], lines 3-5).

Regarding Claims 7, 28 Micher teaches at least one marker structure being positioned on said substrate within one of the group consisting of a chip area and a scribe-lane (paragraph [0032], lines 4-17).

Regarding Claims 8, 29, Micher teaches at least one marker structure being a part of a device pattern within a chip area (paragraph [0032], lines 4-17).

Regarding Claims 9, 30, Micher teaches at least one marker structure comprising a diffraction grating (paragraph [0044], lines 9-12).

Regarding Claims 10, 31, Mieher teaches preprocessing the obtained calibration spectral measurement data ([0044]) and the obtained spectral measurement data before said employing said regression coefficients (paragraph [0037], [0080]).

Regarding Claims 11, 32, Mieher teaches preprocessing comprising performing on said data at least one of the group of mathematical operations consisting of subtraction of a mean, division by standard deviation, selection of optical parameters and weighing of optical parameters (paragraphs [0060]-[0068]), and wherein the optical parameters include at least one of the group of parameters consisting of wavelength, angle and polarization state (paragraph [0003]).

Regarding Claims 12, 33, Mieher teaches each of said plurality of calibration marker structure sets comprising at least a first and a different second calibration marker structure (paragraph [0008], lines 10-11).

Regarding Claims 16, 37, Mieher teaches at least one calibration structure within a calibration marker structure set and said marker structure have substantially comparable shapes (paragraphs [0032], [0044], lines 16-24).

Regarding Claims 18, 19, 39, 40, Mieher teaches method being related to at least one of a lithographic apparatus and a track ([0002]), and at least one process parameter is selected from a group consisting of focus, exposure dose, overlay error, track parameters related to dose, variation of line width over reticle, variations from reticle-to-reticle, projection lens aberrations, projection lens

flare, and angular distribution of light illuminating the reticle (paragraph [0003]).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 20 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mieher et al. (Publication No. US 2003/0048458) in view of Bowley, Jr. et al. (U.S. Patent No. 6,917,901). Hereafter, "Mieher" and "Bowley".

Regarding Claims 20, 41, Mieher teaches an illumination system configured to provide a beam of radiation (paragraph [0002], lines 5-8);

the patterning structure serving to impart the beam of radiation with a pattern in its cross-section (paragraph [0002], lines 9-11);

a projection system configured to project the patterned beam onto a target portion of the substrate (paragraph [0002], lines 8-11).

However, Mieher does not teach a support structure and a substrate table. Bowley teaches a support structure configured to support a patterning structure (Figure 1, elements 110 and 120), (column 4, lines 49-53), a substrate table configured to hold the substrate (column 4, lines 54-57). It would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Mieher by adding a support structure and a substrate table for supporting the patterning structure and holding the substrate in order to improve the measurement process for a

lithographic apparatus.

(10) Response to Argument

A) Independent claims 1, 22:

a) Appellant argues that Shape Parameter Information is not Spectral Measurement Data. The rejection takes the position that shape parameter information is a type of spectral measurement data and that therefore Mieher's operation on shape parameter information anticipates Appellant's recited spectral measurement data.

Examiner respectfully disagrees with the Appellant's arguments. According to the previous rejections, examiner had already explained that shape parameter information of measurement spectra is an only type of spectral measurement data. To support this point, Mieher has disclosed: "the scatterometry data (e.g., **measure spectra) is interpreted into shape parameter information**", (Mieher, paragraph [0009], lines 5-8. Paragraph [0080], lines 1-3).

MSN Encarta Dictionary defines "interpret" as the following:

Definition:

1. *transitive verb* **find meaning of something:** to establish or explain the meaning or significance of something
2. *transitive verb* **ascribe meaning to something:** to ascribe a particular meaning or significance to something
   - *I interpreted his gesture as an invitation.*

Using the above definition, shape parameter information is ascribed the meaning of measure spectra data. In other words, shape parameter information of measurement spectra is only an explanation, a particular meaning of spectral measurement data.

Furthermore, according to paragraph [0047], Mieher disclosed: "Although, the method

described herein does not directly compare spectra (e.g., it compares shape information rather than spectra), **it should be noted that this is not a limitation and that the spectra may be compared**." Therefore, comparing the spectra measurement data has been disclosed by Mieher, and comparing "spectra measurement data" is not different from comparing "shape parameter information". In other words, it is reasonable to construe "spectra measurement data" as "shape parameter information".

b) Appellant argues that Mieher's Regression Analysis is not the Recited Regression Analysis. (i) by using known values of at least one process parameter and (ii) by employing a multi-variant regression technique on the calibration spectral measurement data. Both steps (i) and (ii) are therefore, needed for "determining a mathematical model" in claim 1. Appellant also asserts that Mieher's regression techniques are used solely for converting scatterometry data into shape parameter information, not for determining the mathematical model and mathematical model in Mieher is determined using shape parameter information - not using calibration spectral measurement data.

Examiner respectfully disagrees with Appellant's arguments. Mieher's regression techniques are used to determine shape parameter information and this step is only one part of the process to determine a mathematical model. Mieher has disclosed both steps (i) and (ii) as follow:

(i) By using the known values of at least one process parameter, (Mieher, paragraph [0060], lines 18-22. Paragraphs [0061-0065].) (Note: The first and second known values process parameters are PP1 and PP2).

(ii) "By employing a multi-variant regression technique on the calibration spectral measurement data", (Micher, paragraph [0066] and paragraph [0080], lines 1-13), (Micher disclosed using the equation various values of the first and second process parameters are supplied to the functions until a minimum error is produced (e.g., closest to zero), this is not different from a multi-variant regression technique, and as discussed above, employing regression technique on the calibration shape parameter data is not different from employing regression technique on the calibration spectral data).

By employing regression techniques until a minimum error is produced; the measured shape parameters, (SP1 measured, SP2 measured) will be determined, and the measured process parameters will be determined, (the values that produce the minimum error correspond to the values $PP_{1measured}$, $PP_{2measured}$, Micher, paragraph[0066], lines 3-5). Therefore, model equation Sum Square Error will also be determined with the values of these parameters, (Sum Square Error = $[SP_1(PP_1,PP_2)-SP_{1measured}]^2 + [SP_2(PP_1,PP_2)-SP_{2measured}]$, Micher, paragraph [0060], lines 18-22. Paragraphs [0061-0066]). (Note: model equation Sum Square Error is not different from a mathematical model). Moreover, Micher also disclosed that when the shape parameters SP1, SP2, and the model equation Sum Square Error are determined by employing regression techniques, a matrix inversion is produced for another mathematical model to determine the process parameter PP1, PP2, (Micher, [0067-0074]. Equations Sum Square Error, $SP_1(PP_1, PP_2)$, $SP_2(PP_1, PP_2)$, $PP_1(SP_1, SP_2, SP_3)$, $PP_2(SP_1, SP_2, SP_3)$ ...).

Upon the above explanations, apparently Micher's regression techniques are not only used for converting scatterometry data into shape parameter information, but also used for determining the mathematical model (Equations Sum Square Error, $SP_1(PP_1, PP_2)$, $SP_2(PP_1,$

PP_2), $PP_1(SP_1, SP_2, SP_3)$, $PP_2(SP_1, SP_2, SP_3)$ ...), and of course, mathematical model in Mieher is determined by using shape parameter information – or by using calibration spectral measurement data, (please see the argument in part **a** as above).

c) Appellant argues that Mieher's Comparing is not the Recited Comparing. The Appellant argues that Mieher describes comparing shape parameter information - not measured spectra - to determine focus exposure conditions. Further, Appellant's claimed invention employs regression coefficients of a mathematical model based on spectral measurement data to determine an unknown value of a process parameter for an object.

Examiner respectfully disagrees with Appellant's arguments. As the examiner's explanation in part **a** as above, Mieher clearly describes comparing shape parameter information - i.e. the measured spectra - to determine focus exposure conditions, (figure 1. Paragraphs [0047, 0060-0074]. Paragraph [0080], lines 1-14), (please see the argument in part **a** as above).

In the examiner's explanation in part **b**, Mieher also describes regression coefficients of a mathematical model based on spectral measurement data, (shape parameter data) to determine an unknown value of a process parameter for an object, ($PP_1(SP_1, SP_2, SP_3)$, $PP_2(SP_1, SP_2, SP_3)$, Mieher, paragraph [0060], lines 18-22. Paragraphs [0061-0074]. Paragraph [0080], lines 1-14).

d) For those reasons, the examiner believes that the rejection of claim 1 is proper.

e) The rejection of independent claim 22 is also proper for the same reasons that

the examiner explained in part a, b and c of claim 1 above.

Accordingly, for the foregoing reasons, the Examiner respectfully submits that a case of anticipation has been established and that the cited portions of Mieher clearly disclosed or taught each and every feature recited in independent claims 1 and 22.

B) Dependent claims:

a) Claims 3 and 24.

Mieher's reference, paragraph [0079] disclosed the scatterometry system. It is inherent that a scatterometry system includes a scatterometer.

b) Claims 4 and 25.

The non-linear regression is disclosed in Mieher's reference, paragraph [0080], lines 13-14, and which is not different from non-linear principal component regression. (Note, in a sentence having the term "selected from a group consisting of", with this term, if one condition is met, (non-linear principal component regression), the whole sentence is true.)

c) Claims 10 and 31.

The limitation "preprocessing the obtained calibration spectral measurement data and the obtained spectral measurement data before said employing said regression coefficients" of claims 10 and 31 is disclosed in Mieher's reference, figure 1, element 12, and paragraphs [0044, 0037, 0080].

d) Claims 11 and 32.

The limitation "performing on said data at least one of the group of mathematical operations consisting of weighing of optical parameters" of claims 4 and 25 is disclosed in Mieher's reference paragraphs [0060-0068]. Moreover, Mieher's reference also disclosed optical parameters such as "sidewall angle". Claims 11 and 32 need to be revised clearly to show that applicant's optical parameters "angle" is not the same as "sidewall angle" of Mieher.

e) Claims 12 and 33.

The limitation "each of said plurality of calibration marker structure sets comprises at least a first and a different second calibration marker structure" is disclosed in Mieher's reference paragraph [0038], lines 13-21; paragraph [0039], lines 13-17; paragraph [0058], lines 27-31; paragraph [0059], lines 11-15; paragraph [0060]; paragraph [0078], lines 18-21; and paragraph [0079], lines 7-11.

f) Claims 18 and 39.

The claims require "method is related to **at least one of** a lithographic apparatus and a track"; wherein, Mieher's reference paragraph [0002] disclosed the optical lithography systems. The optical lithography systems are not different from lithographic apparatus. (Note, after the term **at least one of**, if one condition is met, the whole sentence is true.)

g) Claims 20 and 41.

According to the above explanation in section **A**, the examiner believes that all limitations of independent claims 1 and 22 are disclosed in Mieher's reference; therefore, the limitation of claims 20 and 41 could not be patentable.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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